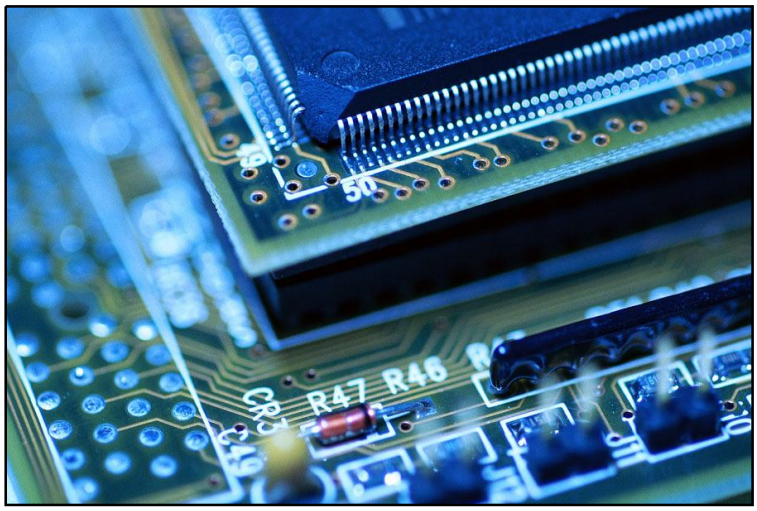
OFFICE OF THE GOVERNOR

ECONOMIC DEVELOPMENT & TOURISM



TEXAS SEMICONDUCTOR INDUSTRY REPORT

SEPTEMBER 2007

P.O. Box 12428 | Austin, TX 78711 | 512-463-2000 |Dial 7-1-1 for Relay Services
www.texaswideopenforbusiness.com

Contents

SEMICONDUCTOR INDUSTRY OVERVIEW ____ 1

GLOBAL SEMICONDUCTOR INDUSTRY MARKETPLACE AND REVENUES ____ 1

U.S. SEMICONDUCTOR INDUSTRY MARKETPLACE ____ 3

TEXAS SEMICONDUCTOR INDUSTRY MARKETPLACE OVERVIEW ____ 5

TEXAS SEMICONDUCTOR INDUSTRY STATISTICS AND EMPLOYMENT ____ 7

TEXAS SEMICONDUCTOR INDUSTRY PATENTS AND EDUCATION STATISTICS ____ 11

TEXAS SEMICONDUCTOR INDUSTRY AREAS ____ 13

- NANOELECTRONICS ____ 13
- RADIO FREQUENCY IDENTIFICATION (RFID) ____ 14
- NANOMEDICINE ____ 15
- PHOTOVOLTAICS ____ 16

SELECTED RECENT TEXAS SEMICONDUCTOR INDUSTRY ACTIVITIES ____ 18

INDUSTRY RESOURCES ____ 20

ENDNOTES ____ 21

SEMICONDUCTOR INDUSTRY OVERVIEW

Semiconductors are materials that conduct electric current, can be easily regulated, and can act as both insulators and conductors. These qualities have made semiconductors useful in the electronics field since its inception. Today semiconductor devices are ubiquitous in a wide range of industries, including computers, communications, aerospace, manufacturing, agriculture, and healthcare. Semiconductors have made electronic devices – such as MP3 players, HDTVs/TVs, CD players, computers, and cell phones – smaller, cheaper, faster, and more reliable.

By the late 1800s, electricity was being used to carry both power and information in electronics devices like telegraphs, telephones, and radios. Semiconductor devices were already used as detectors in radios. In 1947, transistors were invented at Bell Telephone Laboratories. They revolutionized electronics because of their inexpensive, flexible, and reliable functionality and low power requirements. Transistors are solid state semiconductor devices that allow the precise control of current and can be used for amplification, switching, and other functions. They are the key active component in most modern electronics. Integrated circuits (ICs) or "chips" were first patented in 1959 by Texas Instruments. ICs are thin chips consisting of several interconnected semiconductor devices, including transistors. Chip miniaturization and mass production advancements in the 1960s led to the development of increasingly inexpensive, efficient products like pocket calculators and digital watches. Microprocessors, the next major innovation, were first patented in the early 1970s almost simultaneously by Intel, Texas Instruments, and others. Microprocessors are electronic components integrating miniaturized transistors and other elements on a single chip that can execute programs and perform functions like calculations and data storage. The best known microprocessor is the central processing unit, or CPU, the semiconductor device driving personal computers. Recent advances in nanotechnology are being used in semiconductor fabrication to further miniaturize electronics, increase processor speeds, and improve functionality.

The semiconductor industry includes companies primarily engaged in manufacturing semiconductors, other components for electronic applications, and semiconductor-making machinery. Industry products include chips or integrated circuits, wafers, transistors, microprocessors, circuit boards, electronic connectors, and most recently, nanotechnology products.

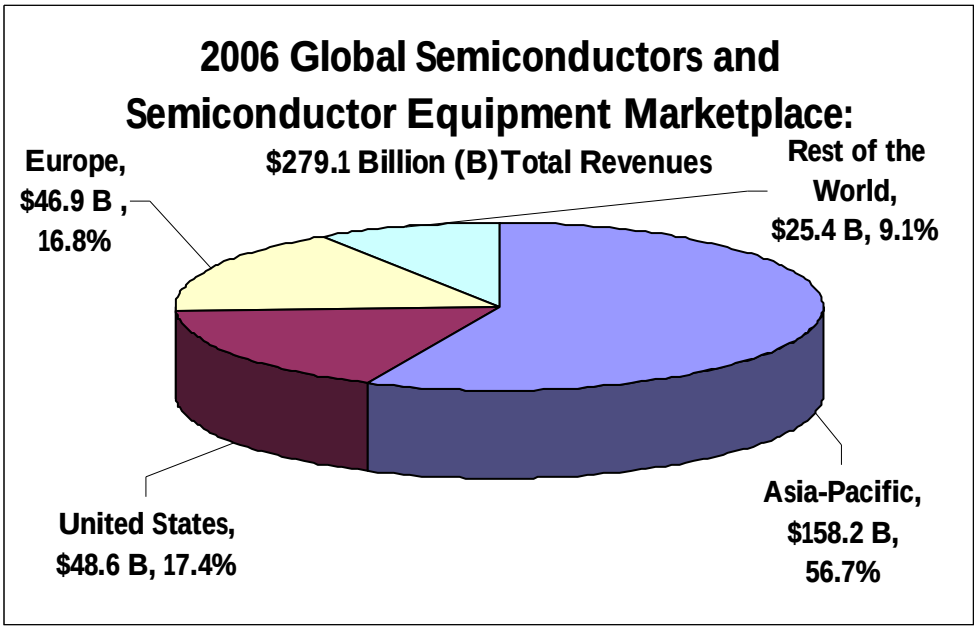
A list of the major semiconductor industry codes from the North American Industry Classification System (NAICS) follows. [i]

NAICS 3344	Semiconductor and Other Electronic Component Manufacturing
NAICS 333295	Semiconductor Machinery Manufacturing

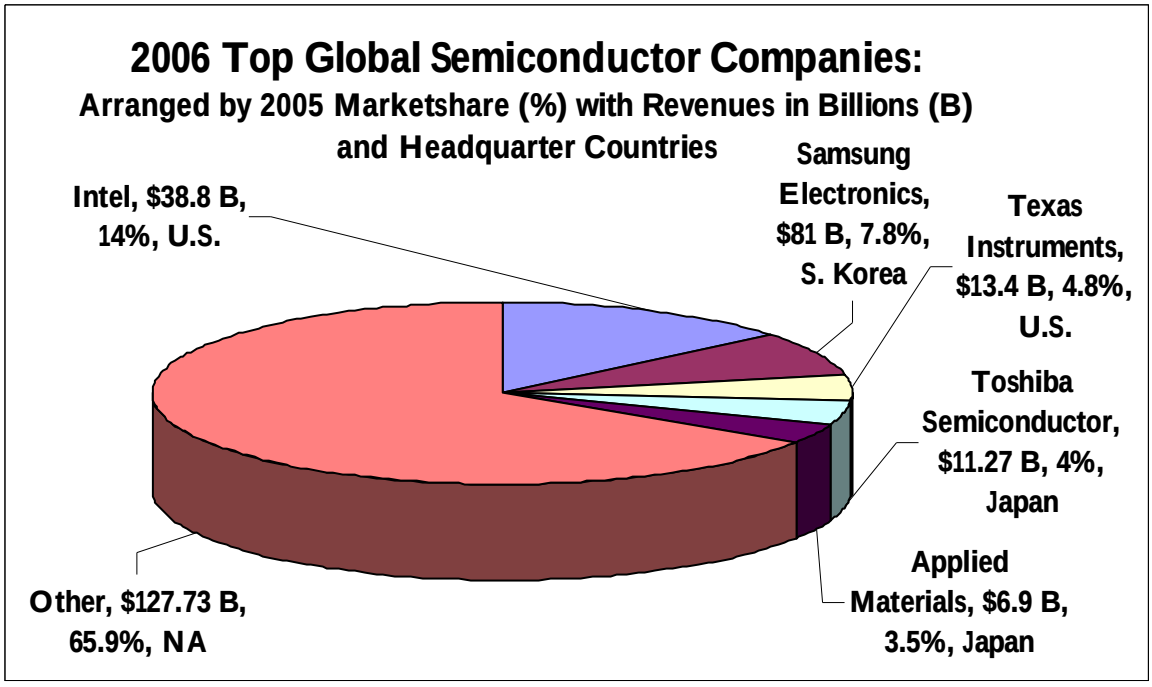
GLOBAL SEMICONDUCTOR INDUSTRY MARKETPLACE AND REVENUES

The global semiconductor industry marketplace grew exponentially in the early 1960s, surpassing $1 billion in sales in 1964. Semiconductor industry growth since then has been cyclical, with marked periods of growth and decline. The latest global industry downturn was from 2000 to 2002, the result of overcapacity and decreased demand coupled with the global economic downturn. Over the past four years, the global semiconductor market has seen increased volume sales, applications, and end markets driven by factors such as the deployment of high-speed and broadband networks, which are creating the need for further capacity.

Datamonitor, a marketing and consulting firm, estimates the value of the 2006 global semiconductors and semiconductor equipment industry marketplace grew 13.1 percent to $279.1 billion in revenues – with semiconductors alone accounting for 89.7 percent or $250.4 billion of that total. The two charts below show that the Asia-Pacific region – in particular China, India, and Japan – grew to $158.2 billion or 56.7 percent of the global market and is also home to three of the top five global semiconductor companies. Datamonitor forecasts that by 2011, the global semiconductors and semiconductor equipment marketplace will be valued at $397.5 billion, an increase of more than 42.4 percent from 2006.



Source: Datamonitor



Source: Datamonitor

** All top 5 companies have Texas locations*

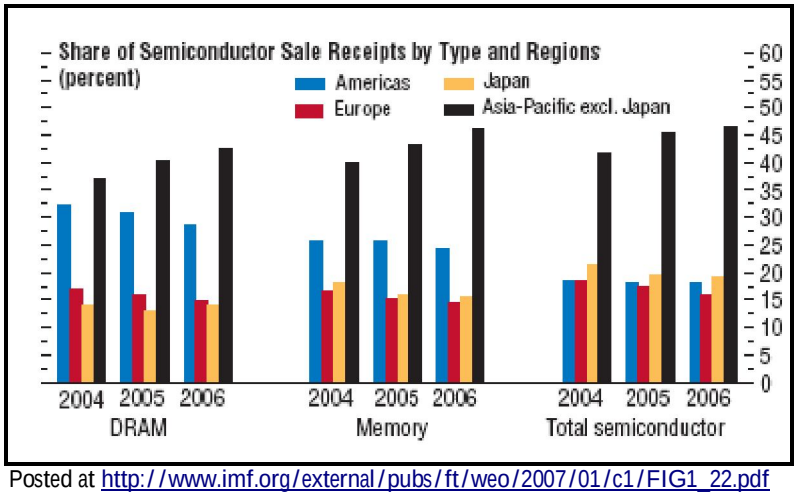
The Semiconductor Industry Association (SIA) reported that global semiconductors sales totaled $247.7 billion in 2006, an increase of 8.9 percent from the $227.5 billion reported in 2005. This growth was primarily driven by popular consumer products, such as cell phones, which shipped over one billion units in 2006. The Asia-Pacific region – driven by China – reported the greatest increases in semiconductor sales, with a growth rate of 12.7 percent in 2006. SIA forecasts 10 percent growth in 2007 to $273.8 billion in worldwide sales.

Recent semiconductor industry trends include adding capacity in anticipation of increased demand, outsourcing manufacturing to areas with inexpensive labor, and fabrication-less (fabless) manufacturing, where all or most processes are outsourced. While volume sales, applications, and end markets are increasing, prices are falling, leading to lean profit margins and overcapacity. There are continuous efforts to develop greater functionality into chips, improve performance, and introduce new technologies so that companies can capture market share and drive further innovations. [ii]

U.S. SEMICONDUCTOR INDUSTRY MARKETPLACE

Datamonitor estimates that the United States accounted for $48.6 billion, or 17.4 percent of the $279.1 billion global semiconductor and semiconductor equipment industry group's value in 2006. Semiconductors alone account for 92.3 percent, or $44.9 billion of that total. The U.S. is home to two of the top five global semiconductors and semiconductor equipment industry companies, including Intel, the top-ranked company by market share. Various sources agree that the U.S. now ranks second to the Asia-Pacific region, after years of being the global leader in the semiconductor marketplace.

The following chart shows global semiconductor industry sales by types and by regions from 2004 to 2006. Asia-Pacific, excluding Japan, led in all areas while the Americas, including the U.S., declined or stagnated.



Posted at http://www.imf.org/external/pubs/ft/weo/2007/01/c1/FIG1_22.pdf
Source: *World Economic Outlook 2007*, International Monetary Fund, April 2007, Figure 1.22: Semiconductor Market

According to the U.S. Bureau of Labor Statistics, preliminary 2006 data in the U.S. semiconductor industry indicate increases in employment, establishments, and wages. In 2006, there were approximately 6,277 U.S. semiconductor industry establishments employing approximately 474,115 people at an average annual salary

of $93,526.50. This is a turnaround from 2005, particularly in the semiconductor machinery manufacturing segment, which previously had declines in all areas. However, overall semiconductor industry employment and establishments' numbers continue to be far lower than at the beginning of the decade. From 2001 to 2006, employee numbers declined approximately 29 percent and establishments declined more than 12 percent. Average weekly and average annual wages have shown steady, slight increases over the past six years.

The following chart shows preliminary 2006 data on the U.S. semiconductor industry using the major industry codes (NAICS).

2006 U.S. SEMICONDUCTOR INDUSTRY INFORMATION					
NAICS	***Description***	***Employees***	***Establishments***	***Avg. Weekly Wage***	***Avg. Annual Pay***
3344	**Semiconductor and Electronic Components**	456,606 (P)	6,053 (P)	$1,451 (P)	$75,467 (P)
333295	**Semiconductor Machinery Manufacturing**	17,509 (P)	224 (P)	$2,146 (P)	$111,586 (P)
OVERALL TOTALS / AVERAGES*	**---**	**474,115 (P)**	**6,277 (P)**	**$1,798.5 * (P)**	**$93,526.5 (P) ***

Source: U.S. Bureau of Labor Statistics
(P) = Preliminary
Private establishments only
* Averages

Efforts to keep semiconductor leadership in the U.S. are ongoing, providing a challenge to federal and state governments. These efforts include increased funding, consortiums, tax policy changes, and education initiatives. The SIA estimates that, as a result of the $1 billion 10-year cost savings to building and operating a semiconductor device manufacturing plant – or fab – in Asia, some two thirds of the world's new 300 mm fabs will be built in Asia. SIA data also indicate that the U.S. semiconductor industry declines are ongoing in both R&D expenditures and manufacturing areas.

A selection of U.S. semiconductor industry marketplace highlights follow:

- Two of the top five global semiconductors and semiconductor equipment industry companies – Intel and Texas Instruments – are based in the U.S.

- In 2006, venture capital (VC) firms invested approximately $2 billion in the U.S. semiconductor industry according to PriceWaterHouseCoopers' MoneyTree Survey. That figure represents approximately 8 percent of the total estimated $26.1 billion VC investment nationwide in all industries.

- According to a July 2007 U.S. Census Bureau's *Current Industry Report*, the total value of shipments of semiconductors, electronic components, and semiconductor manufacturing equipment in 2006 was $120.6 billion, a 1.1 percent decrease from 2005. Shipments of just the semiconductor machinery segment increased 27.3 percent to $12.4 billion in 2006.

- According to the SIA, in 2005 the U.S. semiconductor industry employed 225,000 and had sales of $110 billion, representing 48 percent of the $225 billion global semiconductor market. The industry had an $18 billion R&D investment, representing 17 percent of sales; capital equipment worth $11 billion or 10 percent of sales; and 77 percent of sales were outside the U.S. market.

- According to the U.S. Census Bureau's 2005 *Annual Survey of Manufactures (ASM)*, the semiconductor and electronic components industry segment (NAICS 3344) had over $9 billion in capital investments, 348,153 employees, approximately $235,373 in value added per employee, and over $120 billion in value of shipments. All these numbers are up from 2004, except for employment. Note that the *ASM* only takes industry codes to the four-digit level. [iii]

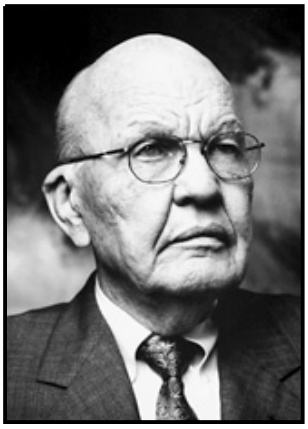
TEXAS SEMICONDUCTOR INDUSTRY MARKETPLACE OVERVIEW

Texas has been a national and global leader in the semiconductor industry since the 1950s. The Lone Star State is nationally ranked in the top 10 for many industry breakouts, is nationally ranked in the top five for industry employment and manufacturing, and is home to one of the top five global semiconductor companies' headquarters. The remaining top four global semiconductor companies have locations in Texas, underscoring the state's industry vitality. Texas is also home to one of the world's top five chip makers and one of the semiconductor industry's leading research consortiums.

Texas has committed substantial resources to the semiconductor industry over the years. In 1987, the Texas Legislature created the Advanced Research Program (ARP) and Advanced Technology Program (ATP) to award grants to fund scientific and engineering projects at Texas higher education institutions. In 2001, the Texas Legislature appropriated $800 million for science, engineering, research, and commercialization activities, including $385 million for research infrastructure. In 2002, the Texas Technology Initiative (TTI) was formed to promote state technological innovations and development through an alliance of state public and business leaders, educators, and entrepreneurs in many advanced technology areas, including semiconductors. In 2003, Gov. Rick Perry and the Texas Legislature passed legislation authorizing the $295 million Texas Enterprise Fund (TEF), a "deal-closing" fund created to attract businesses and new jobs to Texas. The TEF fund was renewed in 2005 with an additional $180 million, and then renewed again in 2007 with an estimated $200 million. In October 2004, Gov. Perry announced a state industry cluster initiative to stimulate long-term growth and economic development in six key areas. The *Advanced Technology and Manufacturing* and *Information and Computer Technology* industry clusters both contains semiconductor elements. In June 2005, Gov. Perry's announced the $200 million Texas Emerging Technology Fund (ETF) to promote and finance technological innovations across multiple industries, including semiconductors. The ETF was renewed in 2007 for more than $165 million. To date, $107.3 million from the TEF and $29.9 million from the ETF have been awarded for semiconductor-related projects. The combination of government and private business support, a highly trained work force, excellent educational and research institutions, a first-rate transportation and logistics infrastructure, and a top-ranked business climate all strengthen the state's status as a semiconductor leader.

A few Texas semiconductor-related industry highlights follow:

- Texas Instruments (TI), headquartered in Dallas, was ranked third by revenues in Datamonitor's 2006 global semiconductor market and second by revenues in Datamonitor's 2006 U.S. semiconductor market. TI has been instrumental in many key semiconductor industry developments. Jack Kilby (1923-2005), a legend in the semiconductor industry, joined TI in Dallas in 1958 and retired from there in 1983. Kilby invented the integrated circuit (IC) in 1958, went on to hold approximately 60 patents, developed popular products like the pocket calculator, and is a Nobel Prize laureate in Physics for his role in the IC invention.



Jack St. Clair Kilby
Source: http://nobelprize.org/nobel_prizes/physics/laureates/2000/

- As of July 2007, the TEF has awarded over $107.3 million for semiconductor-related projects. A chart with details follows.

SEMICONDUCTOR-RELATED TEF AWARDS (ARRANGED BY DATE)

Company	*City*	*Jobs*	*Capital Investment*	*TEF Grant - Date Announced*
Texas Instruments	Richardson	1,000	$3,000,000,000	$50,000,000 - Jun03
Maxim Integrated Products	San Antonio	500	$90,000,000	$1,500,000 - Dec03
SEMATECH	Austin	4,000	$190,000,000	$40,000,000 - Mar04
Samsung	Austin	900	$2,500,000,000	$10,800,000 - Apr06
Maxim Integrated Products	San Antonio	1,000	$200,000,000	$5,000,000 - May07
TOTALS	---	**7,400**	**$5,980,000,000**	**$107,300,000**

Source: Texas Office of the Gov., Economic Development & Tourism at http://www.governor.state.tx.us/divisions/ecodev/ed_bank/files/TEF_Grant_Listing.pdf

- As of July 2007, the ETF has awarded over $29.9 million for semiconductor-related projects: $6.75 million were for commercialization awards, $16.25 million were for research superiority awards, and $8.67 million were for matching awards. A chart with details follows.

SEMICONDUCTOR-RELATED ETF AWARDS (ARRANGED BY COMPANY / ENTITY)

Company / Entity	*City*	*Industry Segment*	*Project Description / Subchapter**	*Funding*
Carbon Nanotubes	Houston	Nanotechnology	Micro fuel cells (E)	$975,000
Global Contour	Rockwell	IT/Defense	Self-sensing electronic technology (E)	$950,000
Molecular Imprints	Austin	Semiconductor	Imprint lithography (D)	$3,000,000
NanoCoolers	Austin	Semiconductor	Nano cooling system (D)	$3,000,000
NRI - UT Dallas, UT Arlington, UT Austin	Dallas, Arlington, Austin	Semiconductor, Energy, Defense, & Life Science	Research grant for the Nanotechnology Research Initiative (F)	$10,000,000
Photodigm	Richardson	IT	Semiconductor lasers (D)	$749,829
SEMATECH	Austin	Semiconductor	ATDF Equipment / Nano research (E)	$5,000,000
SWAN - UT Austin	Austin	Semiconductor	Research grant for CMOS Scaling by Southwest Academy of Nanotechnology (SWAN) / (F)	$1,750,000
Texas Tech	Lubbock	Semiconductor, Energy, Defense, & Life Science	Nanophotonics (F)	$2,000,000
UT Health Science Center	Houston	Health Sciences	Biomedical Nanotechnology R&D (F) (Hired Dr. Mauro Ferrari)	$2,500,000
TOTAL	---	---	---	**$29,924,829**

Source: Texas Office of the Gov., Economic Development & Tourism, Emerging Technology Fund Office
* Subchapter D = commercialization grants; Subchapter E = matching grants; Subchapter F = research superiority grants

- Freescale Semiconductor, a privately held company headquartered in Austin, is a global leader in the design and manufacture of embedded semiconductors for the automotive, consumer, industrial, networking and wireless markets. The company's 2006 sales totaled $6.4 billion.

- In 1987, the semiconductor consortium SEMATECH was founded and headquartered in Austin. The consortium was created as a way for semiconductor companies to work in cooperation to regain the nation's status as a world-leader in semiconductor research and manufacturing. Over the years, SEMATECH has had leading semiconductor companies as members, established both domestic and

international partnerships, developed many innovations, expanded to become an international consortium, and proven itself in a highly competitive marketplace. Current members include Advanced Micro Devices, Hewlett-Packard, IBM, Infineon, Intel, NEC, Panasonic, Samsung Electronics, and Texas Instruments. Texas is also home to SEMATECH subsidiaries ISMI (International Semiconductor Manufacturing Initiative), ATDF (Advanced Technology Development Facility), and the Advanced Materials Research Center (AMRC). [iv]

TEXAS SEMICONDUCTOR INDUSTRY STATISTICS AND EMPLOYMENT

Texas semiconductor industry statistics and employment figures indicate steady growth, a strong national presence, and a solid support base. According to the Texas Workforce Commission (TWC), from 2006Q1 to 2007Q1 there were slight increases in the number of Texas semiconductor industry establishments**.** Most significantly, TWC figures indicate that from 2006Q1 to 2007Q1, the total semiconductor industry's **a**verage employment increased by 3,727 or 6.5 percent**,** weekly wages increased by $307, and average annual pay increased by $15,964**.** According to the U.S. Census Bureau's 2005 *Annual Survey of Manufactures*, Texas ranked in the top three nationally in the semiconductor and electronics components industry area for capital investments, employees, value added per employee, and value of shipments. The Dallas-Fort Worth, Houston, Austin, and San Antonio metropolitan areas account for most of the state's semiconductor industry employment.

The following chart provides a snapshot of the 2007Q1 Texas semiconductor industry using the major industry codes (NAICS).

2007Q1 TEXAS SEMICONDUCTOR INDUSTRY INFORMATION					
NAICS	***Description***	***Employees***	***Establishments***	***Avg. Weekly Wage***	***Avg. Annual Pay***
3344	**Semiconductor and Electronic Components**	56,599	457	$1,981	$103,012
333295	**Semiconductor Machinery Manufacturing**	445	18	$2,153	$111,956
OVERALL TOTALS / AVERAGES*	**---**	**57,044**	**475**	**$2,067 ***	**$107,484 ***

Source: Texas Workforce Commission Quarterly Employment & Wages * Averages

The following chart, published in April 2007, indicates that the state's semiconductor and other electronic components' employment has been increasing since 2006.

Source: Federal Reserve Bank of Dallas at http://www.dallasfed.org/data/hotstats/techempl.html

The following chart provides information from the most recent U.S. Census Bureau's *Annual Survey of Manufactures (ASM)* on the Texas semiconductor industry using the major industry codes (NAICS). Note that the *ASM* only provides data to the four-digit level and that the NAICS 3344 data are incomplete.

2005 TEXAS & U.S. SEMICONDUCTOR MANUFACTURING INFORMATION					
Region	*NAICS/Description*	*Employees*	*Value Added*	*Value of Shipments*	*Total Capital Investments*
TEXAS	**3344/Semiconductor and Electronic Components**	**38,190**	**$7.3 Billion**	**$13.8 Billion**	**$2.5 Billion**
U.S.	**3344/Semiconductor and Electronic Components**	348,153	$81.9 Billion	$120.1 Billion	$9 Billion
TEXAS NATIONAL RANKING	**---**	**2**	**3**	**2**	**1**

Source: Annual Survey of Manufactures, 2005

The following chart lists some of the leading companies operating in the Texas semiconductor industry:

TOP SEMICONDUCTOR COMPANIES IN TEXAS (ARRANGED BY EMPLOYMENT)

Company	City	Business Description
Freescale Semiconductor	Austin	Semiconductors and integrated circuits
Texas Instruments	Dallas, Sherman	Semiconductors
Advanced Micro Devices	Austin	Microchips
Applied Materials	Austin	Semiconductor production equipment manufacturing
Dallas Semiconductor	Dallas	Electronic chips & chip-based subsystems
STMicroelectronics	Carrollton	Electronic Components
Samsung Austin Semiconductor	Austin	Dynamic Random Access Memory (DRAM) chips
National Semiconductor Corporation	Arlington	Semiconductors and integrated circuits
MEMC Southwest	Sherman	Silicon and solar wafers
Cirrus Logic	Austin	Semiconductors and integrated circuits
TriQuint Semiconductor Texas	Richardson	Semiconductors and integrated circuits
Toppan Photomasks	Round Rock	Semiconductor photomasks

Sources: 2007 Directory of Texas Manufacturers, published by Manufacturers News Inc.; Hoover's Pro Premium; Austin Chamber of Commerce website at http://www.austin-chamber.org/DoBusiness/GreaterAustinProfile/business.html

A selection of Texas semiconductor industry statistics highlights follows:

- Texas is currently home to approximately 11.5 percent of the world's silicon processing capacity, according to the University of Texas at Austin's IC2 Institute.
- In January 2007, *Small Times Magazine* ranked Texas fifth overall in its annual ranking of the top 10 micro and nanotechnology states.

- Texas ranked second nationally for semiconductor venture capital (VC) investment in 2006 and second nationally in 2007 to date. In 2007Q1, VC firms invested $38 million in the Texas semiconductor industry according to the PriceWaterHouseCoopers MoneyTree Survey. In 2006, $145 million was invested in the Texas semiconductor industry, up from $121 million in 2005.

- From 2000 to 2007 to date, the U.S. Department of Defense (DoD) granted Texas approximately $26.7 million in unclassified semiconductor-related SBIR (Small Business Innovation Research) awards. DoD classified awards aren't disclosed**.**

- From 2001 to 2007 to date, the National Science Foundation (NSF) granted Texas over $5.7 million in semiconductor-related SBIR awards.

- According to the American Electronics Association's (AeA) publication *Trade in the Cyberstates 2007*:

    - Texas was the nation's second largest semiconductor technology exporting state in 2006 with $10.5 billion in semiconductor exports. Semiconductors were the state's top-ranked high-tech export.

    - Texas was the nation's second largest overall high-tech exporting state with $39 billion in tech exports, representing 26 percent of the state's total exports.

    - Texas ranked second nationally for employment related to high-tech exports with 100,600 jobs.

    - Texas high-tech exports grew by $4.5 billion in 2006, making it the nation's fastest growing state.

    - Twenty-six percent of Texas' exports are high-tech exports with leading destinations of Mexico ($14.6 billion), Canada ($3.5 billion), and South Korea ($2.5 billion).

- According to the AeA's publication *Cyberstates 2007*:

    - In 2006, Texas ranked third nationally in venture capital investments at $1.4 billion.

    - In 2005, Texas ranked second nationally in *semiconductor manufacturing* employment with 35,100 jobs and second in high-tech employment with 445,800 jobs.

    - In 2005, Texas high-tech firms employed 56 of every 1,000 private sector workers, for which the state ranked 16th nationally.

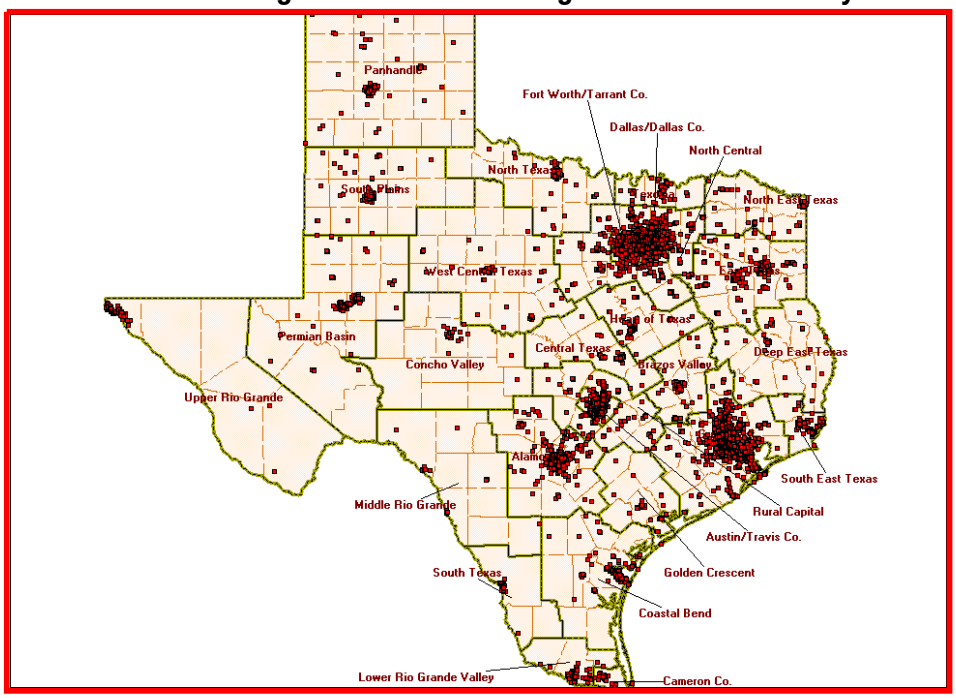
    - In 2005, Texas ranked second nationally for a high-tech payroll of $33.6 billion.

    - In 2005, Texas high-tech employees earned an average wage of $75,400, for which the state ranked 12th nationally. The state's high-tech average wage was 84 percent higher than the average private sector wage. [v]

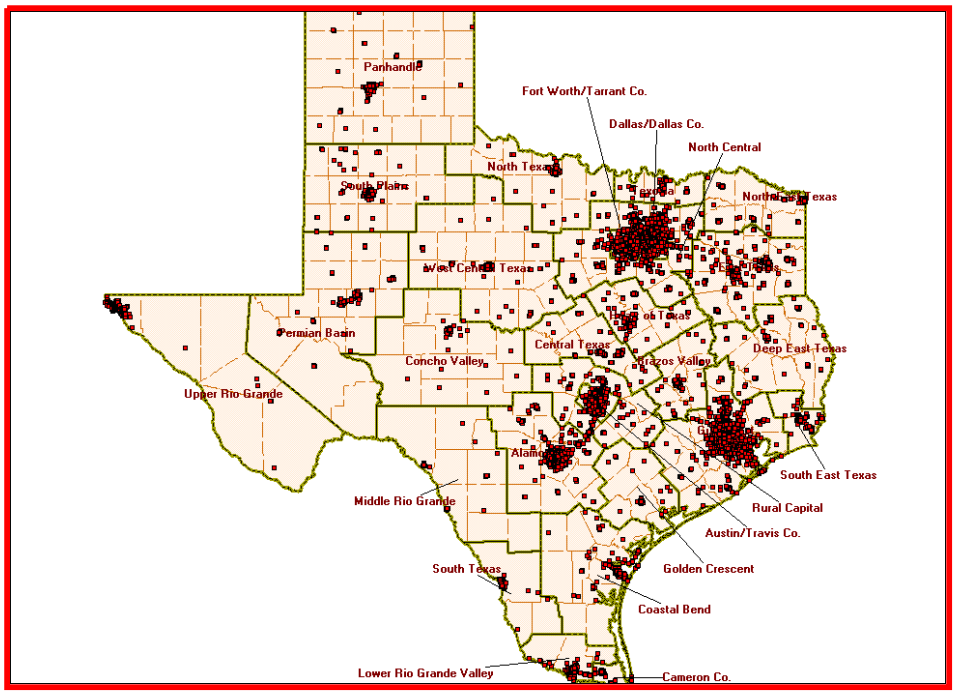
The following Texas Workforce Commission (TWC) maps show that the state's core semiconductor manufacturing facilities are located in or near the Dallas-Fort Worth, Austin, San Antonio, and Houston metropolitan areas. The *Advanced Technology and Manufacturing* and *Information and Computer Technology* industry clusters both contain semiconductor elements. The maps also indicate that semiconductor manufacturing

facilities are distributed across the state, from the Texas Panhandle to the Rio Grande Valley and from El Paso to Texarkana.

Advanced Technologies and Manufacturing Cluster: Core Industry Sectors



Information and Computer Technology Cluster: Core Industry Sectors



Source: Industry Clusters GIS at http://www.texasindustryprofiles.com/apps/gis/clustersgis/

TEXAS SEMICONDUCTOR INDUSTRY PATENTS AND EDUCATION STATISTICS

Texas public universities and other educational institutions are significantly invested in semiconductor industry-related research and development (R&D), leading to continual discoveries. The Lone Star State has a number of top 10 rankings in education, R&D, and patent areas in or related to the semiconductor industry.

A selection of state statistics follows:

- The Southwest Research Institute (SwRI), headquartered in San Antonio, provides contract research and development services to industrial and government clients across industries, including semiconductors. SwRI's headquarters employs over 3,000 and occupies almost two million square feet of office and laboratory space on over 1,200 acres in San Antonio. SwRI's 2006 revenues were $455 million. During 2006, SwRI provided $5 million to fund innovative research through its internally sponsored R&D program.

- The University of Texas at Dallas' (UTD) Erik Jonsson School of Engineering & Computer Science indicates that for the second year in a row, UTD conferred the most computer science degrees in the nation, according to American Society of Engineering Education data. UTD also indicates it ranks fourth nationally when all the degrees awarded in electrical engineering and computer science are combined.

- In FY2006, total R&D expenditures in Texas institutions of higher education totaled over $3.18 billion. Engineering and computer science accounted for $476.6 million or 14.9 percent.

- In FY2006, total R&D expenditures for microelectronics & computer technology in Texas institutions of higher education were over $74 million.

- In 2005, Texas ranked third nationally for academic R&D expenditures at $3.047 billion and second nationally for the number of utility patents issued to state residents, according to the National Science Foundation (NSF).

- In 2004, Texas ranked first nationally in state and local government-funded R&D expenditures and fourth nationally for federal R&D expenditures with $1.65 billion, according to the NSF.

- In 2004, Texas ranked fifth nationally in total R&D expenditures, which were estimated at $14.4 billion according to the AeA's publication *Cyberstates 2007*.

- In FY2004, Texas received over $5.02 billion from federal agencies for R&D, ranking fifth nationally. Most of this funding, $3.17 billion, came from the U.S. Department of Defense.

- In 2003, Texas ranked second nationally for the number of doctoral engineers, third for the number of doctoral scientists, and third for the number of science and engineering doctorates awarded, according to the NSF.

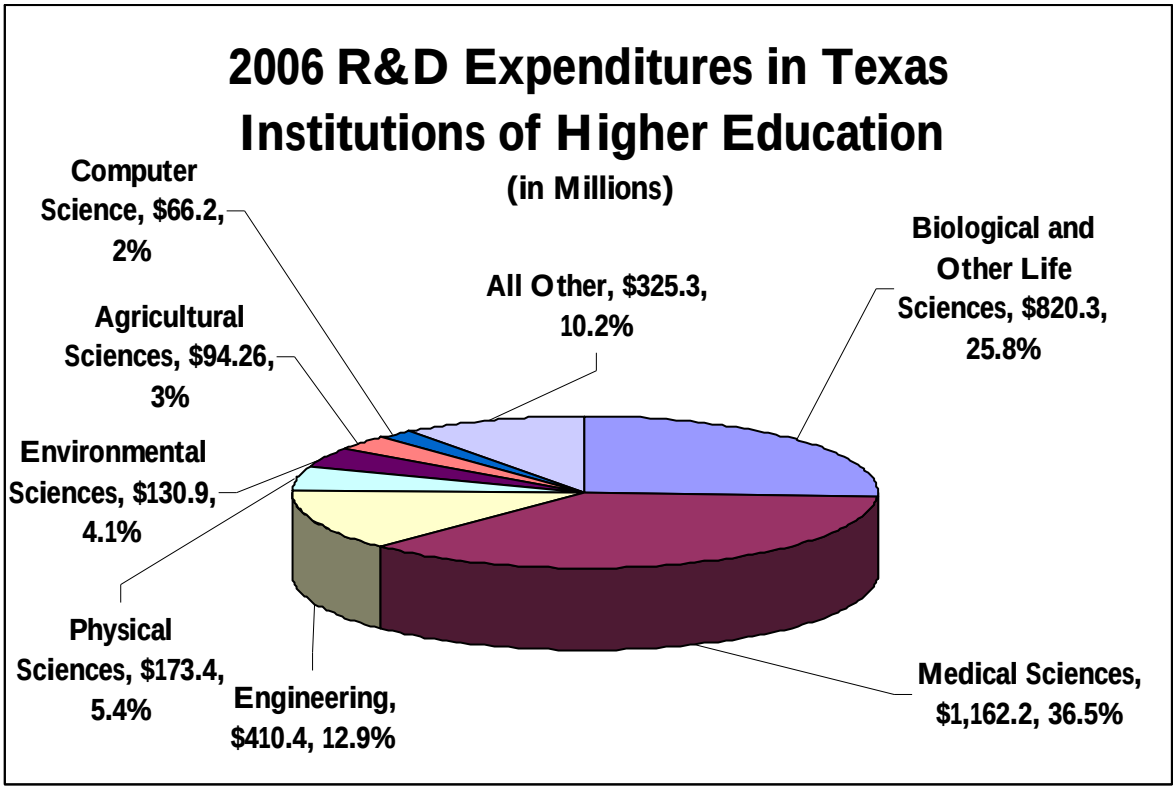
- Between 2001 and 2005, an estimated 2,778 Texas semiconductor utility patents were issued. Semiconductor device manufacturing patents accounted for most of these patents. From 2002 to 2005, Texas ranked third nationally for patent class 438 and fourth nationally for patent class 257. The following chart provides more detailed Texas semiconductor patent data. [vi]

2001-2005 TEXAS SEMICONDUCTOR UTILITY PATENTS

Class	Class Title	2001	2002	2003	2004	2005	Total
438	Semiconductor Device Manufacturing: Process	343	290	240	267	207	**1347**
716	Design and Analysis of Circuit or Semiconductor Mask (Data Processing)	23	42	55	44	31	**195**
257	Active Solid-State Devices (e.g., Transistors, Solid-State Diodes)	140	121	121	138	121	**641**
327	Miscellaneous Active Electrical Nonlinear Devices, Circuits, and Systems	92	84	92	62	65	**395**
326	Electronic Digital Logic Circuitry	44	31	33	35	45	**188**
117	Single-Crystal, Oriented-Crystal, and Epitaxy Growth Processes; Non-Coating Apparatus	3	4	3	0	2	**12**
---	**TEXAS TOTALS**	**645**	**572**	**544**	**546**	**471**	**2,778**
---	**U.S. TOTALS**	**5,097**	**5,429**	**5,628**	**5,580**	**5,081**	**26,815**

Source: United States Patent and Trademark Office at http://www.uspto.gov/web/offices/ac/ido/oeip/taf/tecstc/classes.htm

The following chart shows FY 2006 R&D expenditure breakouts by disciplines in Texas institutions of higher education. They totaled over $3.18 billion, with Engineering and Computer Science accounting for $476.6 million or 14.9 percent.



Source: Texas Higher Education Coordinating Board at http://www.thecb.state.tx.us/reports/PDF/1331.PDF

The following chart lists FY 2006 semiconductor-related R&D expenditures at selected Texas universities. It also indicates the top five institutions in each subject area.

FY 2006 HIGHEST SEMICONDUCTOR-RELATED R&D EXPENDITURES AT SELECTED TEXAS PUBLIC AND PRIVATE UNIVERSITIES

Selected Texas Institutions	*Microelectronics & Computer Technology*	*Computer Science*	*Engineering*	*Materials Science*
Rice	*$12,150,412*	*$9,166,930*	*$19,597,904*	$2,177,878
Texas A&M University and Services	*$8,817,664*	*$9,000,060*	*$147,258,769*	*$7,757,050*
Texas Tech University	$1,846,369	$1,143,413	$12,429,653	*$3,103,396*
University of Houston	*$4,823,435*	*$5,534,864*	*$18,186,780*	*$3,865,673*
University of North Texas	$1,172,146	$409,385	$5,128,091	*$4,462,263*
University of Texas at Arlington	*$4,147,073*	$2,078,008	*$16,569,691*	$2,702,090
University of Texas at Austin	*$36,495,159*	*$26,860,567*	*$148,868,437*	*$15,786,110*
University of Texas at Dallas	$974,933	*$6,398,866*	$14,414,150	$1,012,365
SELECTED TEXAS UNIVERSITIES' TOTALS	**$70,427,191**	**$60,592,093**	**$382,453,475**	**$40,866,825**
ALL TEXAS UNIVERSITIES' TOTALS	**$74,086,212**	**$66,201,503**	**$404,363,870**	**$44,242,692**

Italicized numbers indicate the five highest in each category.
Source: Texas Higher Education Coordinating Board at http://www.thecb.state.tx.us/reports/PDF/1331.PDF

TEXAS SEMICONDUCTOR INDUSTRY AREAS

NANOELECTRONICS

The term *nanoelectronics* refers to electronics at the nanoscale – from one to 100 nanometers – and represents just one application of nanotechnology. Nanoelectronics cross a number of industries, including automotive, aerospace, energy, and defense. The semiconductor industry has pioneered the use of nanotechnology to miniaturize and revolutionize electronics, which is critical to many industry advances.

Texas is a leader in nanoelectronics, actively supporting nanoelectronics research and commercialization efforts and experiencing steady growth within the marketplace**.** Numerous Texas institutions of higher education and commercial businesses are researching and developing nanotechnology and nanoelectronics-derived products and services. A selection of recent Texas nanoelectronics industry area activities and statistics follows:

- Texas is well represented in the national Nanoelectronics Research Initiative (NRI), a Semiconductor Industry Association (SIA) effort launched nationwide in 2004 to accelerate nanoelectronics research primarily in U.S. universities for the benefit of the semiconductor industry. The Nanoelectronics Research Corporation (NERC), a non-profit research management group, administers the NRI program. Texas-based NRI industry members include Texas Instruments and Freescale Semiconductor; Texas-located NRI industry members include Advanced Micro Devices, IBM, Intel,

and MICRON Technology. Texas-based NRI participating universities include Rice University, Texas A&M University, the University of Texas (UT) Austin, and UT Dallas.

- The Advanced Materials Research Center (AMRC), an Austin-based subsidiary of SEMATECH, the Texas-based semiconductor consortium, was formed in 2004 with the University of Texas system and other Texas universities to investigate promising new semiconductor technologies – including nanoelectronics – and help ensure the state's high-tech future. AMRC research focuses on areas including nanotechnology, micro-electro-mechanical systems (MEMS), information technology, biotechnology, and advanced energy applications.

- In September 2006, Gov. Rick Perry announced two nanotechnology initiatives. The first was that Texas had been awarded a prestigious nanoelectronics research center by the National Science Foundation (NSF) and Semiconductor Research Corporation (SRC). Called the Southwest Academy of Nanotechnology (SWAN), the new Texas research center is partially funded by the NSF and SRC and is the third such research center in the nation. The University of Texas System approved $10 million in funding to help launch the initiative and UT Austin's Microelectronics Research Center serves as SWAN's headquarters under the direction of Dr. Sanjay Banerjee. Other SWAN funding came from a new Nanotechnology Research Initiative (NRI) in Texas, which was the second nanotechnology initiative announced by Gov. Rick Perry. The NRI is a $30 million public-private partnership funded by a $10 million grant from the Texas Emerging Technology Fund (TEF), $10 million from the UT System, and the remaining $10 million from private industry. The Texas NRI includes a "Top Talent" initiative component, which is statewide and includes the entire UT System.

- In September 2006, Texas launched a $4 million Nanolectronics Workforce Development Initiative, a multi-year program led by Austin Community College and jointly developed by SEMATECH, ATDF, and Texas State Technical College-Waco (TSTC). The initiative is to train technicians and engineers in nanoelectronics to meet future industry growth needs.

- From 2001 through 2006, the NSF granted Texas over $1.8 million in nanoelectronics-related SBIR awards.

- From 2000 through 2005, the U.S. DoD has granted approximately $7 million in unclassified nanoelectronics-related SBIR (Small Business Innovation Research) awards. DoD classified awards aren't disclosed. [vii]

RADIO FREQUENCY IDENTIFICATION (RFID)

RFID technology enables electronic identification by storing and retrieving data via tiny radio devices called RFID tags, or transponders. RFID tags contain integrated circuits to store and process information, as well as generate a radio frequency signal. The tags also contain antennas to receive and transmit radio signals. RFID technology is used to track, monitor, and inventory everything from goods, documents, livestock, to people. It is used across industries including healthcare, retail supply chain management, agriculture, transportation, information technology, defense, and automotive.

Texas is home to the global market's RFID tag manufacturing leader and has rolled out RFID technology on the state's tollroad system.

- Texas Instruments indicates it is the world's largest integrated manufacturer of RFID tags, RFID smart labels, and RFID reader systems. TI has been a major player in the RFID industry since the 1990s, establishing an RFID division in 1991. TI's RFID offerings include transponders, readers, antennas, software, and accessories.

- The Texas Center for Digital Knowledge is a University of North Texas (UNT) at Denton-based research, development and consulting service enterprise that brings together top researchers from multiple disciplines to focus on various emerging technologies, including RFID. In July 2005, an RFID initiative called the RFID Research Group was formed. It is comprised of over 80 UNT participants.

- In 2004, major retailers Wal-Mart and Target independently announced they planned their first trials of RFID technology in Texas. In 2006, Wal-Mart announced that RFID pilots resulted in a 16 percent reduction in the number of times products went out of stock. Over the past three years, the number of Wal-Mart stores using RFID has increased tenfold, from 100 stores in 2004 to 1,000 stores in 2007. However, for retailers overall, RFID adoption has slowed; primarily due to return on investment issues.

TxTag
Graphic Source: http://www.txtag.org/tagbasics.php

- In 2005, the Texas Department of Transportation (TXDOT) selected TransCore's eGo Plus RFID technology for the Central Texas Turnpike Program, a $2 billion transportation initiative. TXDOT has rolled out RFID-embedded cards called "TxTags," which allow customers to pay tolls electronically at discounted rates from a prepaid account while traveling tollways without having to stop at toll booths.

- From 1998 through 2007 to date, the NSF granted Texas about $400,000 in RFID-related SBIR awards.

- From 2002 through 2006, the U.S. DoD has granted over $3.3 million in unclassified RFID-related SBIR awards. DoD classified awards aren't disclosed.

NANOMEDICINE

The medical industry has led in the adoption of nanotechnology – including nanoelectronics – to combat conditions including heart disease, cancer, diabetes, strokes, and infections. Nanoelectronics in nanomedicine are being used in detection, diagnosis and prevention via imaging and in treatment via drug delivery. Texas is a global leader in nanomedicine with one of the greatest concentrations of nanotechnology research in the world including over 150 leading nanotechnology researchers, more than 55 medical research institutions and research parks, and one of the world's largest medical complexes.

- The Texas Medical Center in Houston is one of the world's largest, best-known, and finest medical complexes and is second only to Boston in total research spending. There are 45 member institutions housed there, including 13 educational institutions and two specialized patient facilities. The educational institutions include Baylor College of Medicine, the University of Texas M.D. Anderson Cancer Center, the University of Texas Health Science Center at Houston, the University of Houston System, Rice University, the Texas A&M University System, Texas Woman's University, Prairie View A&M University, Texas Southern University, and the Houston Community College System.

- The Texas-based Alliance for NanoHealth (ANH), comprised of seven world-class institutions, was the first multi-disciplinary, multi-institutional collaborative research endeavor aimed solely at using nanotechnology to bridge the gaps between medicine, biology, materials science, computer technology and public policy. ANH is comprised of three medical research universities within the Texas Medical Center and two highly-renowned scientific institutions, all within a five mile radius. In 2006, ANH received $6.4 million in federal funding.

ANH Logo Graphic Source:
http://www.nanohealthalliance.org/about-us

Dr. Mauro Ferrari
Photo Source: http://gsbs.uth.tmc.edu/tutorial/ferrari.html

- In April 2006, The University of Texas Health Science Center (UTHSC) at Houston hired Dr. Mauro Ferrari, one of the founders of the biomedical nanotechnology field and with a strong record in commercialization. An award from the ETF played a key role in Dr. Ferrari's recruitment package. Dr. Ferrari joined the Brown Foundation Institute of Molecular Medicine for the Prevention of Human Diseases at UTHSC at Houston as a professor of nanotechnology. He also serves as the President of the Alliance for NanoHealth. Dr. Ferrari has served as a Special Expert to the National Cancer Institute on nanotechnology. He is the founder and editor of the journal *Biomedical Microdevices*, the oldest journal dedicated to this relatively new area of medicine.

PHOTOVOLTAICS

Solar energy can be converted into electricity using photovoltaic (PV) devices, a semiconductor application. PVs have become a commercially viable source of renewable energy due the dynamics and increased demands of the global energy market and the declining costs and high reliability of PVs. Texas is a top-ranked national leader in photovoltaic research and development, which is fitting since the state has long been a leader in the energy and semiconductor industries. The Lone Star State is ranked first nationally for its renewable energy resources, which include PVs, as well as its renewable energy potential. The state also has excellent climatic conditions, with some of the sunniest areas of the nation located in West Texas.

- Texas is top ranked nationally in various photovoltaic innovation and productivity areas, according to the following charts from the June 2007 study *Photovoltaics in Texas* published by The University of Texas at Austin's IC2 Institute.

Table 1. Photovoltaic Innovation Scorecard

Rank of Texas PV efforts among U.S. Leaders	Federal Rsch Awards *	PV Patents 1**	Scientific Publications	Business Establishments
California	1	1	1	1
Colorado	2	5	2	3
Massachusetts	3	3	5	6
Texas	4	4	9	5
Florida	5	9	8	2
Ohio	6	7	3	11
New York	7	2	4	4
Michigan	8	6	11	8
New Mexico	8	10	6	7
Pennsylvania	8	7	7	9
Virginia	8	11	10	10

* 1993 - 2005 **1991 - 2005

Source: IC² Institute and Rand RadiUS, USPTO, ISI Web of Knowledge, Sourceguides.com

Table 2. Productivity in Photovoltaics

	# Federal Rsch Awards *	% of U.S. Total	# Scientific Publications **	% of U.S. Total	# Photovoltaic Patents **	# PV Businesses
California	62	15%	261	20%	289	310
Colorado	44	11%	255	19%	63	85
Massachusetts	35	8%	101	8%	73	34
Texas	18	4%	44	3%	68	65
Florida	17	4%	52	4%	30	94
Ohio	15	4%	125	10%	55	14
New York	14	3%	113	9%	83	76
Michigan	13	3%	40	3%	59	29
New Mexico	13	3%	53	4%	27	31
Pennsylvania	13	3%	53	4%	55	22
Virginia	13	3%	41	3%	13	19
% of U.S. Total		**62%**		**87%**		

* 1993 - 2005 **1991 - 2005

Source: IC² Institute and Rand RadiUS, ISI Web of Knowledge, USPTO, Sourceguides.com

Charts' source:
http://www.utexas.edu/ati/cei/documents/TexasSolarOpportunity2007.pdf

- Renewable energy adoption, including PVs, has been accelerated by the Texas Renewable Portfolio Standard (RPS) legislation initiated in 1999. The Texas RPS mandated the construction of certain amounts of renewable energy, prompting the Texas renewable energy industry to grow rapidly, and has been so successful it has become the national model for RPS programs. In 2005, the renewed and expanded Texas RPS legislation increased the state's RPS goal to 5,880 MW by 2015, of which, 500 MW must come from non-wind resources. The legislation also set a goal of 10,000 MW in renewable energy capacity by 2025.

- PVs are being used across Texas for everything from powering school crosswalk warning signs and ranch electric fences to powering homes and water pumping stations. [viii]

PV-powered irrigation pumps
Photo source: http://www.seco.cpa.state.tx.us/re_solar_pv.htm#factsheets

SELECTED RECENT TEXAS SEMICONDUCTOR INDUSTRY ACTIVITIES

A selection of recent, major Texas semiconductor industry activities follows.

- On August 19, 2007, it was announced that Dr. Yves Chabal, one of the world's foremost semiconductor authorities, was joining the University of Texas at Dallas. He will become the first holder of the Texas Instruments Distinguished University Chair in Nanoelectronics. The $2 million chair was funded by the Texas Nanoelectronics Research Superiority Initiative (formerly the Texas NRI) and a permanent endowment for the Erik Jonsson School of Engineering and Computer Science, where Dr. Chabal will serve.

Dr. Yves Chabal
Photo source: http://www.ecs.utdallas.edu/newsandevents/Chabal.html

- On June 14, 2007, Samsung Austin Semiconductor's manufacturing plant held its grand opening. The largest, state-of-the-art 300mm NAND flash memory wafer plant expansion is the result of a $10.8 million Texas Enterprise Fund (TEF) grant announced by Gov. Perry in April 2006. Parent company Samsung Electronics invested $3.5 billion in the project, making it the largest single foreign investment in Texas and one of the largest in the United States. Previously, the largest foreign investment in Texas was the existing Samsung memory plant, which cost about $1.4 billion in 1996. The new plant will create thousands of new jobs, encompasses more than one million square feet of manufacturing and office space, and will produce flash memory chips used by MP3 players and similar hand-held devices.

Gov. Perry (2nd from left) at Samsung Austin Semiconductor's manufacturing plant
Photo source: http://www.samsung.com/PressCenter/PressRelease/images/m_20070614.jpg

- Samsung has had a chip manufacturing plant in Austin since 1997.

- In September 2005, Samsung Electronics Co. Ltd. became a full member of SEMATECH, the Austin-based semiconductor research consortium. As one of the top global semiconductor manufacturers, Samsung's decision is a significant endorsement of Texas and SEMATECH. Earlier in 2005, Samsung joined the International Sematech Manufacturing Initiative (ISMI), a SEMATECH subsidiary.

- In July 2004, Samsung Austin Semiconductor broke ground on its 34,000 square foot expansion in Austin, planned to produce next generation nano-scale semiconductor memory technology. The company announced its three year, $500 million investment to expand and upgrade its Austin facility in May 2003.

- In May 2006, Texas Instruments completed its Richardson Fabrication facility (RFAB). TI broke ground on the RFAB – its largest, most expensive production facility ever – in November 2004. The RFAB cost over $3 billion, is 1.1 million square feet, and includes administration, mechanical, support, and fabrication buildings. When fully operational, TI's RFAB will employ about 1,000 and will manufacture 45-namometer and beyond chips on 300mm wafers. TI's expansion was the largest job creation announcement in the nation in 2003, the year it was announced.

  - In June 2003, Gov. Rick Perry announced more than $300 million in new funding from a combination of public and private sources to place TI's next major semiconductor manufacturing plant in Richardson – in conjunction with improvements to UTD's engineering program, with the goal of UTD having a top 50 engineering school in five years. The $300 million included a $50 million grant from the Texas Enterprise Fund to enhance engineering and computer science programs at UTD. The UTD investment played a key role in TI's decision to build a new fabrication plant in Texas.

  - UTD's Erik Jonsson School of Engineering & Computer Science has made a number of related announcements and developments since 2004, including a November 2004 groundbreaking on a new $85 million Natural Science and Engineering Research Laboratory facility and Dr. Chabal's August 2007 appointment mentioned above.

- In March 2007, the Semiconductor Industry Association announced one of the recipients of its 2007 University Research Awards was University of Texas at Austin's Professor Paul S. Ho. Professor Ho holds the Cockrell Family Regents Chair in Materials Science and Engineering, acts as Director of the Laboratory for Interconnect and Packaging, has been involved in research programs sponsored by the Semiconductor Research Corporation (SRC) for 13 years, and has made groundbreaking contributions to interconnect reliability technology.

Professor Paul S. Ho

Photo source: http://www.cei.se/instructors/ho_paul.htm

- In March 2007, the Semiconductor Industry Association announced one of the recipients of its 2007 Leadership Awards was Senator John Cornyn (R, TX) for his efforts to improve U.S. math and science education.

- In October 2005, Advanced Micro Devices Inc. (AMD) submitted plans to the City of Austin for the development a large corporate campus in Southwest Austin. Construction on the new AMD campus is currently underway and is scheduled for completion in January 2008. The $190 million project is seeking a gold certification from the U.S. Green Building Council.

- In December 2004, Freescale Semiconductor. officially spun-off from Motorola, Inc. In April 2005, Freescale announced its global headquarters would be in Austin, Texas. Freescale became a private company in a 2006 buyout estimated at $17.6 billion. Freescale is one of the world's largest semiconductor companies with 2006 sales of $6.4 billion. [ix]

INDUSTRY RESOURCES

AeA (formerly the American Electronics Association) at http://www.aeanet.org
A national non-profit trade association representing all segments of the electronics industry, including semiconductors. AeA offers some free industry data and publications on its website.

The Federal Reserve Bank of Dallas at www.dallasfed.org
A U.S. government website profiling Texas economic and demographic data. Note the *Hot Stats – Texas High Tech Employment* report, updated regularly, at
http://www.dallasfed.org/data/hotstats/techempl.html.

National Science Foundation (NSF) at http://www.nsf.gov
NSF is a federal agency that promotes the progress of science. The NSF website has a wealth of publications and statistics covering many aspects of science and engineering on the state, national, and international levels.

SEMATECH at http://www.sematech.org
SEMATECH is a Texas-based consortium of global semiconductor companies. The website includes some publications such as a semiconductor dictionary at
http://www.sematech.org/publications/dictionary/index.htm, news items, and links to other websites including the Texas Technology Initiative and the International Technology Roadmap for Semiconductors.

SEMI at http://www.semi.org
This global semiconductor industry association website offers free market data and statistics, news, events information, and more.

Semiconductor Industry Association (SIA) at www.sia-online.org
SIA is a U.S. trade association. The SIA website offers U.S. and global market statistics, press releases, industry facts and history, and more.

State Energy Conservation Office (SECO) at http://www.seco.cpa.state.tx.us/index.htm
The SECO oversees the state's energy efficiency and renewable energy programs and provides information on technologies and administrates a number of state programs. The SECO is part of the Texas Comptroller's Office.

Texas Nanotechnology Initiative (TNI) at http://www.texasnano.org
TNI is a consortium of Texas-based academic, business, and political entities and individuals interested in promoting the state as a leader in nanotechnology, including nanoelectronics. The website offers news items, a calendar, related links, and more.

World Semiconductors Trade Statistics (WSTS) at http://www.wsts.org
WSTS is a nonprofit association. The website offers semiconductor business resources, including world market statistics. Most resources are available to members only.

ENDNOTES

[i] *Media Resources: What is a Semiconductor?,* Semiconductor Industry Association, http://www.sia-online.org/pre_resources_FAQ_Semiconductor.cfm, accessed August 2007; *North American Industry Classification System,* United States, 2002; *SIA & Semiconductor Industry History,* Semiconductor industry Association, www.sia-online.org/abt_history.cfm, accessed August 2007; *Semiconductor History*, Micron, http://www.micron.com/k12/semiconductors/history.aspx, accessed August 2007; *Texas Instruments History of Innovation*, http://www.ti.com/corp/docs/company/history/tihistory.shtml, accessed August 2007; *Semiconductors*, *Semiconductor Device*, *Nanoelectronics, Integrated Chip*, *Microprocessor*, and *Transistor,* Wikipedia: The Free Encyclopedia, http://en.wikipedia.org/wiki/, accessed August 2007; *Global Semiconductors & Semiconductor Equipment*, Datamonitor Market Research Profiles, March 2007.

[ii] *Global Semiconductors & Semiconductor Equipment*, Datamonitor Market Research Profiles, March 2007; *Global Semiconductors,* Datamonitor Market Research Profiles, December 2006; *Semiconductors in Asia-Pacific*, Datamonitor Market Research Profiles, December 2006; *Global Chip Sales Hit Record $247.7 Billion in 2006*, Semiconductor Industry Association, http://www.sia-online.org/pre_release.cfm?ID=426.

[iii] *Global Semiconductors & Semiconductor Equipment*, Datamonitor Market Research Profiles, March 2007; *Semiconductors in the United States*, Datamonitor Market Research Profiles, December 2006; *Profile of U.S. Semiconductor Industry*, Semiconductor Industry Association, April 2, 2006, http://www.sia-online.org/downloads/Profile.pdf; *Quarterly Census of Employment and Wages Data Query Page*, U.S. Bureau of Labor Statistics, http://data.bls.gov/PDQ/outside.jsp?survey=en; *2005 Annual Survey of Manufactures*: *Geographic Area Statistics*, U.S. Census Bureau, http://www.census.gov/mcd/asm-as3.html; *Historical Trend Data*, PriceWaterHouseCoopers MoneyTree Survey, http://www.pwcmoneytree.com/moneytree/nav.jsp?page=historical, accessed August 2007; *Keeping Semiconductor Leadership in the U.S.*, Semiconductor Industry Association, http://www.sia-online.org/backgrounders_Semiconductor_Leadership.cfm; *Semiconductors, Printed Circuit Boards, Other Electronic Components: 2006*, U.S. Census Bureau, July 2007, http://www.census.gov/industry/1/ma334q06.pdf.

[iv] *Perry Signs Bill Creating Emerging Technology Fund*, June 13, 2005, http://www.governor.state.tx.us/divisions/press/pressreleases/PressRelease.2005-06-13.4031/view; *Gov. Rick Perry Announces Strategic Plan to Create Jobs*, October 20, 2004, http://www.governor.state.tx.us/divisions/press/pressreleases/PressRelease.2004-10-20.2446/view; *The Texas Technology Initiative*, http://www.texasnano.org/pdfs/TTI_description_letter_2-15-05.pdf; *Jack Kilby,* Wikipedia: The Free Encyclopedia, http://en.wikipedia.org/wiki/, accessed August 2007; *Corporate Overview*, Freescale Semiconductor website, http://www.freescale.com/webapp/sps/site/overview.jsp?nodeId=060A60, accessed August 2007; *SEMATECH website,* http://www.sematech.org/, accessed August 2007.

[v] *Historical Trend Data*, PriceWaterHouseCoopers MoneyTree Survey, http://www.pwcmoneytree.com/moneytree/nav.jsp?page=historical, accessed August 2007; *Tech Exports from Texas Grew the Fastest in 2006*, AeA, July 19, 2007, http://www.aeanet.org/PressRoom/prac_TCS_2007_texas.asp; *Texas's Tech Industry Adds 10,300 Jobs,* AeA, April 24, 2007, http://www.aeanet.org/PressRoom/prjj_cs2007_texas.asp; *Award Search Website*, National Science Foundation, http://www.nsf.gov/awardsearch/, accessed August 2007; *DoD SBIR/SSTR Awards Basic Search Website*, Department of Defense (DoD), http://www.dodsbir.net/Awards/Default.asp, accessed August 2007; *Cyberstates 2007*, AeA, April 2007; *U.S. Technology Reports up by $21 Billion in 2007*, AeA, July 17, 2007, http://www.aeanet.org/PressRoom/prac_TCS_2007.asp; *Annual Survey of Manufacturers: Geographic Area Statistics: 2005*, U.S. Bureau of Census, http://www.census.gov/mcd/asm-as3.html; *State Rankings*, Small Times Magazine, January 2007,

http://smalltimes.com/display_article/281856/109/ARTCL/none/none/State-Rankings/; *Opportunity on the Horizon: Photovoltaics in Texas*, The University of Texas at Austin's IC2 Institute, June 2007, http://www.utexas.edu/ati/cei/documents/TexasSolarOpportunity2007.pdf.

[vi] *Cyberstates 2007*, AeA, April 2007; *Science and Engineering State Profiles: 2003-05*, May 2007, National Science Foundation, http://www.nsf.gov/statistics/nsf07322/; *Research Expenditures, September 1, 2005 – August 31, 2006,* Texas Higher Education Coordinating Board, June 2007, Tables 4, 5, 9 and 10 and Figure 5, http://www.thecb.state.tx.us/reports/PDF/1331.PDF; *Patenting in Technology Classes, Breakout by Geographic Origin (State and Country)*, 2000-2004, U.S. Patent and Trade Office, http://www.uspto.gov/web/offices/ac/ido/oeip/taf/tecstc/classes.htm, accessed August 2007; *Facts about SwRI*, http://www.swri.org/6swsa/work/facts.htm, accessed August 2007; *UTD Jonsson School – Facts*, UTD, http://www.ecs.utdallas.edu/welcome/facts.html, accessed August 2007.

[vii] *Nanoelectronics Definition*, Answers.com, http://www.answers.com/topic/nanoelectronics?cat=technology, accessed August 2007; *About NRI*, http://nri.src.org/member/about/default.asp, accessed August 2007; *Texas and SEMATECH Launch Advanced Materials Research Center in Austin to Preserve Technology Leadership and Pave Way for Tomorrow's Employers*, SEMATECH Press Release, March 29, 2004, http://www.sematech.org/corporate/news/releases/20040329.htm; *ARMC Research*, http://www.amrctx.org/techareas.htm#nano, accessed August 2007; *SIA Launches Nanoelectronics Research Initiative*, December 1, 2004, SIA Press Release, http://www.sia-online.org/pre_release.cfm?ID=343; *Perry Announced 2 Nanotechnology Initiatives*, September 27, 2006, http://www.governor.state.tx.us/divisions/press/pressreleases/PressRelease.2006-09-27.4643/view; *UT System to Launch Nanoelectronics Initiative*, July 14, 2006, http://www.utsystem.edu/news/2006/BOR-Nanoelectronics-07-14-06.htm; *Nanoelectronics Workforce Development Initiative*, http://www.sematech.org/research/nwdi/index.htm; accessed August 2007; *DoD SBIR/SSTR Awards Basic Search Website*, Department of Defense (DoD), http://www.dodsbir.net/Awards/Default.asp, accessed August 2007; *Award Search Website*, National Science Foundation, http://www.nsf.gov/awardsearch/, accessed August 2007.

[viii] *Radio-Frequency Identification*, Wikipedia: The Free Encyclopedia, http://en.wikipedia.org/wiki/RFID#Human_implants, accessed August 2007; *TI-RFID ™ & Contactless Commerce*, Texas Instruments, http://www.ti.com/rfid/default.htm, accessed August 2007; *Texas Department of Transportation to Use RFID Technology for New Tolling Projects*, September 21, 2005, http://www.govtech.com/gt/articles/96707; *Three Years of Retail RFID Pilots*, Lora Cecere, Forbes Magazine, May 2, 2007, http://www.forbes.com/logistics/2007/05/02/amr-rfid-assess-biz-logistics-cx_lc_0502amr.html; *Target to Launch Its RFID Program in Texas*, August 11, 2004, http://www.eweek.com/article2/0,1895,1634788,00.asp; *Wal-Mart Begins Roll-Out of RFID at 7 Supercenters*, Wal-Mart Press Release, April 30, 2004, http://retailindustry.about.com/b/a/083095.htm; *Texas Center for Digital Knowledge: About Us*, http://www.txcdk.org/initiatives.php, accessed August 2007; *UNT Forms Team to Foster new RFID Initiatives*, University of North Texas, July 23, 2005, http://www.ntxe-news.com/cgi-bin/artman/exec/view.cgi?archive=11&num=27394; *TxTag Basics*, Texas Department of Transportation, http://www.txtag.org/tagbasics.php; *DoD SBIR/SSTR Awards Basic Search Website*, Department of Defense (DoD), http://www.dodsbir.net/Awards/Default.asp, accessed August 2007; *Award Search Website*, National Science Foundation, http://www.nsf.gov/awardsearch/, accessed August 2007; *Radio Frequency Identification*, Encyclopedia of Emerging Industries: Online Edition, Thomason Gale, 2006; *Nanotechnology Pioneer Ferrari Joins UT Health Science Center*, University of Houston Press Release, April 17, 2006, http://www.uthouston.edu/Media/newsreleases/nr2006/IMM-Ferrari.html; *About the Texas Medical Center*, http://www.texmedctr.tmc.edu/root/en/GetToKnow/AboutTMC/About+the+TMC.htm, accessed August 2007; *About Nanohealth Alliance*, http://www.nanohealthalliance.org/about-us, accessed August 2007; *Opportunity on the Horizon: Photovoltaics in Texas*, The University of Texas at Austin's IC2 Institute, June 2007, http://www.utexas.edu/ati/cei/documents/TexasSolarOpportunity2007.pdf; *Renewable Energy in Texas*, State Energy Conservation Office (SECO), http://www.seco.cpa.state.tx.us/re.htm, accessed August 2007; *Photovoltaics: Solar Electricity*, SECO, http://www.seco.cpa.state.tx.us/re_solar_pv.htm, accessed August 2007;

Texas Renewable Portfolio Standard, SECO, http://www.seco.cpa.state.tx.us/re_rps-portfolio.htm, accessed August 2007.

[ix] *Gov. Perry Attends Grand Opening of Samsung Austin Semiconductor Facility*, June 14, 2007, http://www.governor.state.tx.us/divisions/press/pressreleases/PressRelease.2007-06-14.3227/view; *SAMSUNG Opens Largest Wafer Plant In Austin*, Texas, June 14, 2007, http://www.samsung.com/PressCenter/PressRelease/PressRelease.asp?seq=20070614_0000354604; *Semiconductor Industry Recognizes Professors Andrew R. Neureuther and Paul S. Ho*, Semiconductor Industry Association, March 8, 2007, http://www.sia-online.org/pre_release.cfm?ID=431; *Semiconductor Industry Honors Spellings, Cornyn and Miller*, Semiconductor Industry Association, March 8, 2007, http://www.sia-online.org/pre_release.cfm?ID=430; *Semiconductor expert Yves Chabal to Join University of Texas at Dallas*, August 19, 2007, http://www.pegasusnews.com/news/2007/aug/19/semiconductor-expert-yves-chabal-join-university-t/; *AMD Lone Star: Cost: $190 Million*, Texas Construction, June 1, 2007; *Gov. Perry Announces $50 Million In Enterprise Funds for UTD*, June 30, 2003, http://www.governor.state.tx.us/divisions/press/pressreleases/PressRelease.2003-06-30.4818/view; *Gov. Perry Breaks Ground for UT-Dallas, Texas Instruments Partnership*, November 18, 2004, http://www.governor.state.tx.us/divisions/press/pressreleases/PressRelease.2004-11-18.5133/view; *Facts on TI's Richardson Fab (RFAB),* Texas Instruments, http://www.ti.com/corp/docs/rennerroadfab/generalfacts.shtml, accessed August 2007; *TI Taps Texas as Site for Next Semiconductor Manufacturing Facility*, PR Newswire, June 30, 2003; *Motorola Declares Spin-Off Date of December 2, 2004*, November 9, 2004, http://www.motorola.com/mediacenter/news/detail/0,,4864_4154_23,00.html#; *Freescale Headquarters to Locate in Austin*, April 1, 2005, http://www.freescale.com/webapp/sps/site/display.jsp?nodeId=093623&filePath=/media_center/news_releases/2005/corp/04-01-05_FSL_HQ_AUSTIN.html&title=News%20Release; *Austin Samsung Semiconductor website*, http://www.sas.samsung.com/, accessed August 2007; *UT-Dallas, Texas Instruments Partnership Breaks Ground*, Texas Construction, Volume 13, Number 1, January 1, 2005; *Samsung Joins SEMATECH*, Austin American Statesman, September 29, 2005; *AMD Submits Plans for $200M Campus*, October 10, 2005, Austin Business Journal, http://austin.bizjournals.com/austin/stories/2005/10/10/story1.html.

Prepared by Business Research staff

Office of the Governor
Economic Development and Tourism Division
PO Box 12428, Austin, Texas 78711
www.governor.state.tx.us/divisions/ecodev
512-936-0101

TEXAS
WIDE OPEN FOR BUSINESS™